LIMITATIONS ON NITROGEN REMOVAL BY TREATMENT WETLANDS IN A COOL MEDITERRANEAN COASTAL REGION

CCoWS

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Purpose

Nitrate runoff from agriculture negatively affects water quality within the California Central Coast; there are over sixty 303d-nutrient impaired water bodies in this area.

Figure 1. Inlet and outlet locations at the Molera treatment wetland. DCR-001 is the inlet location used in this study and DCR-003 is the outlet used in this study.

Table 1. AIC analysis of the hypothesized Tobit regression models on the influence of the predictor variables on denitrification within the Molera treatment wetland.
C: Dissolved organic carbon, T: Temperature, Z:zero-order decay, F:first-order decay, initial nitrate concentrations are encompassed in the first and combined zero/first order models.

Model	Multiple		
	Df	ΔAIC	AIC_w
H_{ZFTC}	**5**	**0**	**0.666**
H_{ZFT}	4	1.4	0.333
H_{ZFC}	4	12.6	0.001
H_{FTC}	3	15.6	0
H_{FC}	4	36.8	0
H_{F}	3	36.9	0
H_{ZTC}	2	48.5	0
H_{FT}	3	50.6	0
H_{0TC}	3	128.5	0
H_{ZC}	4	128.9	0
H_{0T}	2	129.8	0
H_{ZF}	3	130.4	0
H_{ZT}	3	133.7	0
H_{0}	2	136.5	0
H_{Z}	2	136.5	0
H_{0C}	2	146.5	0

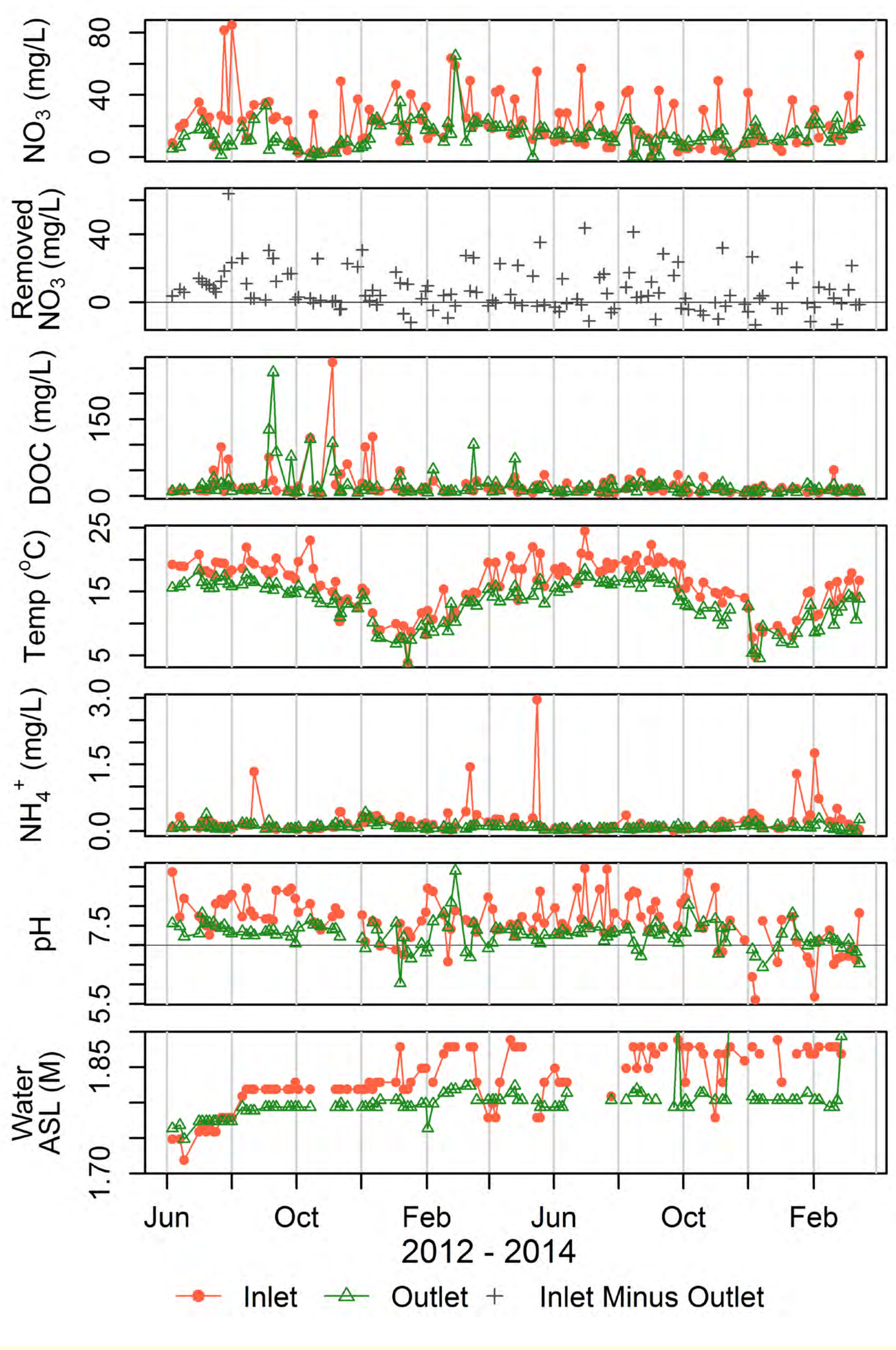

Figure 2. Measured physical and chemical characteristics at the inlet and outlet of the Molera treatment wetland observed between June 2012 and March 2014.

Results

Nitrate was removed throughout the entire year (Fig. 2). There was decisive evidence that nitrate removal was greatest at higher temperatures and inlet nitrate concentrations (Table 1). There was minimal evidence that carbon influenced nitrate removal. Initial nitrate concentrations had the largest influence on nitrate removal ($\beta_{N,std}$ = -10.120), followed by temperature ($\beta_{T,std}$ = -2.594), and then carbon ($\beta_{C,std}$ = -1.249).

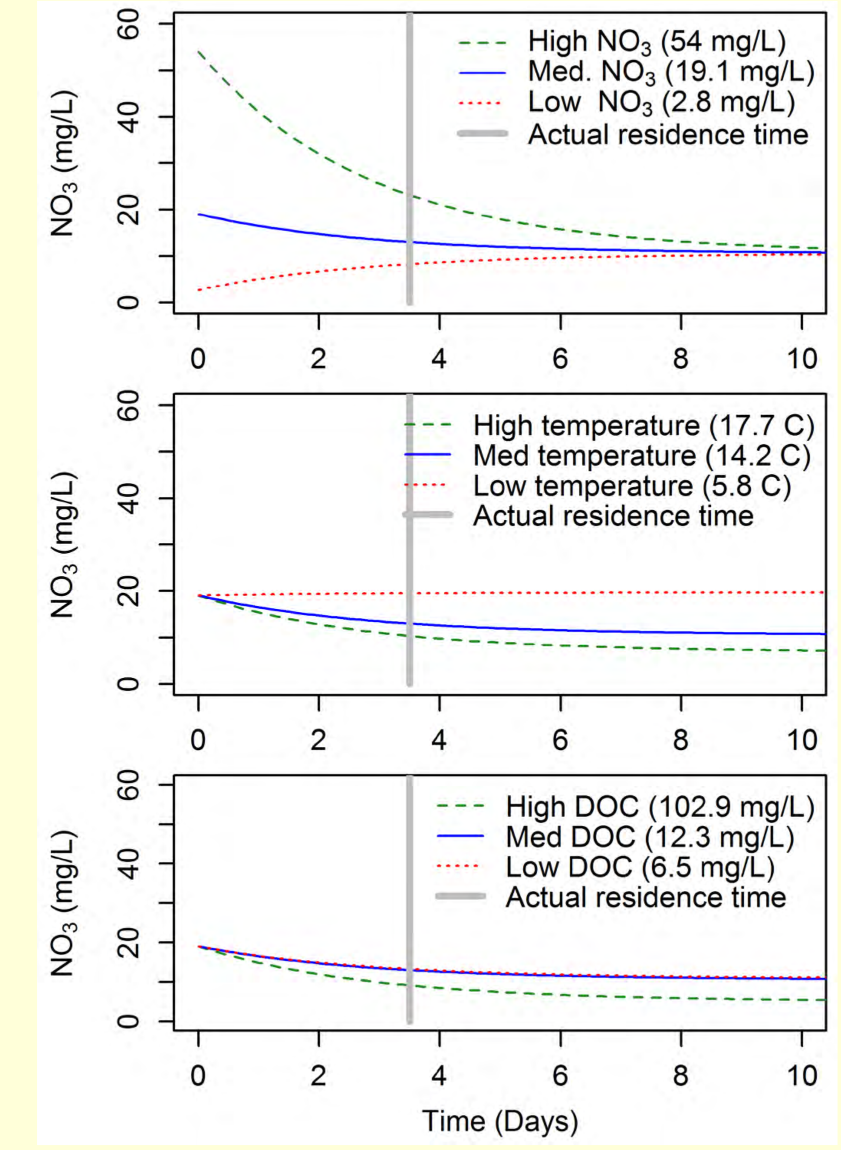

Figure 3. Modeled nitrate removal using values derived from the best AIC model.

Goal

My goal was to analyze the limitation of temperature, carbon and nitrate supply on nitrate removal by treatment wetlands in a cool Mediterranean coastal region. I postulated that the Molera wetland would remove more nitrate from the system when water temperatures were the highest and nitrate removal would be limited by carbon content.

Methods

The study site was at the Molera treatment wetland, located in Castroville, CA (Fig. 1). Water samples were collected at the wetland every 3.5 days June 2012 through March 2014. I examined my postulates by hypothesizing that the distribution of outlet nitrate concentrations (N_{out}) could be predicted either by the following model for the mean outlet concentration (μ_{out}) or a subset of it:

$$H_{ZFTC}: \mu_{out} = N_{in,lag} + \beta_0 + \beta_N N_{in,lag} + \beta_T T + \beta_C C$$

To examine my postulates models were fit to my data and compared using Akaike's Information Criterion (AIC) analysis.

Conclusion

Treatment wetlands can be used to improve water quality within the central coast. To increase nitrate removal efficiency, wetlands should be augmented with carbon, or planted with vegetation known to maximize nitrate removal. Furthermore insulating wetlands will further maximize nitrate removal.